

## 13.0 Graphoepitaxy of Colloidal Crystals

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## 13.1 Graphoepitaxy of Colloidal Crystals

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This part of the project aims to use surface sensitive x-ray scattering to study the structure of Langmuir-Blodgett films pulled in the standard way from monolayers on the surface of water. These films have potential for device applications and are also model systems for studying the structure of two-dimensional materials.

Last year experiments were carried out on a Langmuir-Blodgett sample with 192 multilayers polymerized with a poly-diacetylene linkage. The layers were pulled from monomers of the cadmium salt of 10,12-nanacosadiynoic acid dispersed on a substrate containing  $10^{-2}\text{M}$  of  $\text{CdCl}_2$ . Polymerization was done by ultraviolet irradiation after the films were pulled. X-ray scattering data for this film that were taken at our beam line at the Brookhaven National Synchrotron Light Source are shown in the figure 13.1; the momentum transfer was normal to the film and shows many harmonics with an interesting alternating intensity of the peaks. No structure could be detected in the plane of the film.

Since then, effort has been devoted to the design and construction of a spectrometer for glancing-angle x-ray scattering from the surfaces of liquids. It has been designed to be used both with on-campus rotating anode x-ray sources and the storage ring at the National Synchrotron Light Source. It will be used to study the structure of the Langmuir film precursors from which the L-B films are drawn.

## 13.2 Growth of Colloidal Crystals

*Joint Services Electronics Program (Contract DAAL03-86-K-0002)*

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The goal of this portion of the project is to use colloidal crystals of polystyrene latex spheres as models to study epitaxial growth on patterned substrates. Using lithographic techniques, it is possible to control the texture and patterns precisely on the "atomic" scale of the model systems - which is about  $0.1\text{ }\mu\text{m}$ . Thus light scattering may be used

to study ordering in these materials in a way analogous to the use of x-rays to study ordinary crystals, with the added advantage that dynamic information can be obtained.

A thin cell in which the ionic strength of the colloid can be reduced to the point where crystallization occurs has been constructed. Preliminary light scattering experiments of the freezing with smooth substrates have been carried out. Unlike the case of x-ray scattering, we have excellent energy resolution with light scattering and can use it to cleanly separate elastic (Bragg) scattering from inelastic (thermal diffuse) scattering. We may also use the technique to study quantitatively the dynamics of the "atomic" motion in the colloidal crystal. Figure 13.1 also shows both the inelastic Bragg scattering intensity, as open circles, and the thermal diffuse intensity was obtained by integrating the inelastic scattered light over the frequency, and has been multiplied by ten to display on the same scale as the elastic scattering.

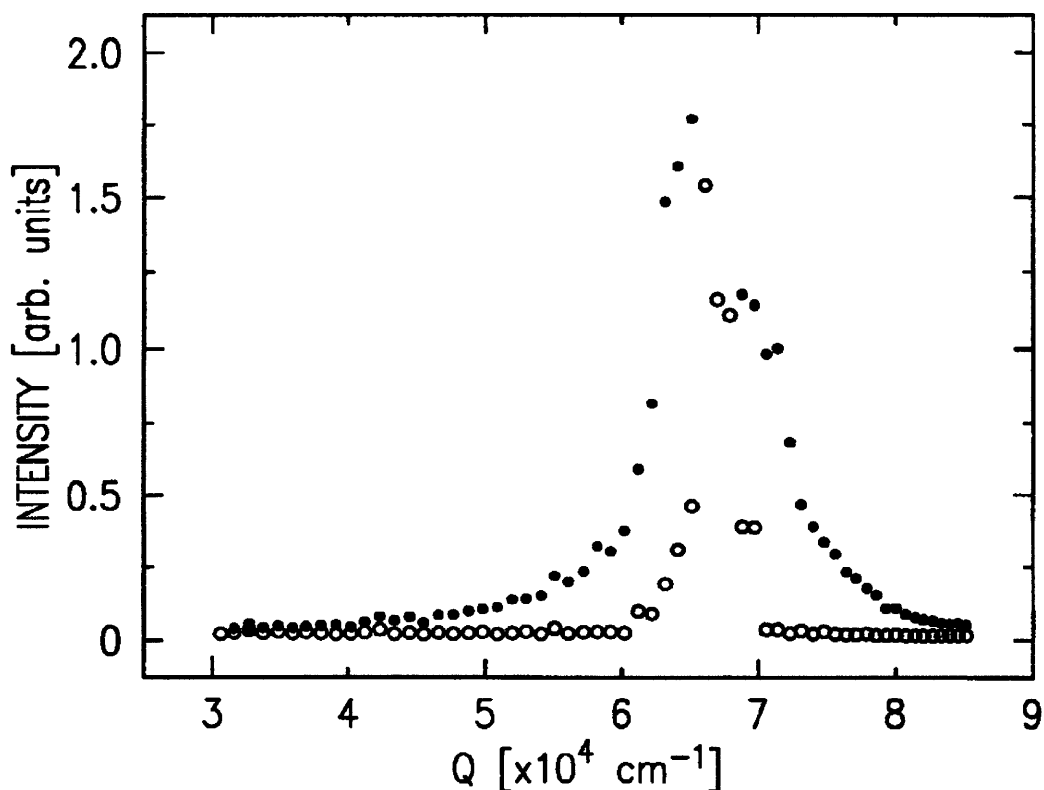


Figure 13.1 Light scattering intensity near a colloidal crystal Bragg peak.